॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २७ मे २०२५ रोजी संपन्न झालेल्या मा. विद्यापरिषद बैठकीतील विषय क्रमांक १६/६१–२०२५ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसारचे पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यास मा. विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी. एस्सी द्वितीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यात येत आहेत.

01	B.Sc. Agriculture Microbiology	11	B.Sc. Physics
02	B.Sc. Botany	12	B.Sc. Seed Technology
03	B.Sc. Dairy Science	13	B.Sc. Horticulture
04	B.Sc. Electronics	14	B.Sc. Statistics
05	B.Sc. Environmental Science	15	B.Sc. Biochemistry
06	B.Sc. Fishery Science	16	B.Sc. Analytical Chemistry
07	B.Sc. Food Science	17	B.Sc. Agrochemical & Fertilizers
08	B.Sc. Geology	18	B.Sc. Industrial Chemistry
09	B.Sc./B.A. Mathematics	19	B.Sc. Industrial Microbiology
10	B.Sc. Microbiology		

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२५–२६/११६
दिनांक ०५.०६.२०२५

सहाय्यक कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : माहितीस्तव तथा कार्यवाहीस्तव.
१) मा. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
२) मा. प्र. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
३) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परीक्षा व मुंल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED - 431 606 (MS)

(Credit Framework and Structure of Four Year UG Program with Multiple Entry and Exit Option as per NEP-2020)

UNDERGRADUATE PROGRAMME OF SCIENCE & TECHNOLOGY

Major in **Agricultural Microbiology** and Minor in **DSM**
(Subject)

Under the Faculty of Science & Technology

(Revised as per the Govt. Of Maharashtra circular dt. 13th March 2024)

Effective from the Academic year 2025 – 2026

(As per NEP-2020)

From the Desk of the Dean, Faculty of Science and Technology

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power***", is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve ***the 3Es, the equity, the efficiency*** and ***the excellence*** in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the cumulative grade point average (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the Choice Based Credit System (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses.

SRTM University has been producing a good number of high calibre graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario.

Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like start-ups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in specialized areas of interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals.

The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general science based to the discipline-specific-based curriculum. All the recommendations of the ***Sukanu Samiti*** given in the **NEP Curriculum Framework-2023** have been followed, keeping the disciplinary approach with rigor and depth, appropriate to the comprehension level of learners. All the Board of Studies (BoS) under the Faculty of Science and Technology of this university have put in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students. We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of

Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the **Government of Maharashtra regarding NEP-2020**. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employability. Introduction of the mandatory ***On Job Training, Internship program*** for science background students is praise worthy and certainly help the students to imbibe firsthand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. M. K. Patil
Dean
Faculty of Science and Technology

From Desk of Chairman, Board of Studies of the Subject Microbiology

Preamble:

The emergence of microbiology many centuries ago is considered one of many of the most important scientific achievements. Since then, it has become a leading field in the biological sciences and a popular course of study in higher institutions worldwide. Like every other B.Sc. programme in tertiary education, B.Sc. Agricultural microbiology has its own set of different syllabi, which students must cover before they are allowed to graduate.

The New Education policy presents an opportunity to shift paradigm from a teacher – centric to student centric higher education system in India. It caters for skill-based education. The learning outcomes-based curriculum framework for a degree in B. Sc. (Honors) Agricultural microbiology is intended to provide a comprehensive foundation to the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. Efforts has been made to integrate use of recent technology in teaching and learning. The syllabus is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum considers the need to maintain globally competitive standards of achievement in terms of knowledge and skills in Agricultural Microbiology as well as develop scientific orientation, problem solving skills, human and professional values which foster rational and critical thinking in the students. This course serves a good opportunity in different fields in Agricultural Microbiology.

In addition to these Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome-based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

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B. Sc. Agricultural Microbiology Program Objectives and Outcomes

PROGRAMME OBJECTIVES:

- To enrich students with knowledge and understanding of the different disciplines of Microbiology such as soil Microbiology, physiology of soil microorganisms, biochemistry, Agro-industries, fermentation technology, environmental Microbiology, genetics, agricultural and food and diary Microbiology, Waste management Biofertilizers, Biocontrol agents and Green Manure productions.
- To introduce the concepts of application and research in Agricultural Microbiology and inculcate sense of scientific responsibilities.
- To help student's build-up a progressive and successful career in Agricultural Microbiology.
- To take a step ahead for the holistic development of students through activities like lectures from eminent personalities, Visits, and various competitions.
- It makes the students competent enough to use Agricultural Microbiology knowledge and skills to analyze problems involving microbes and undertake remedial measures.
- In addition, students are to be trained to use this knowledge in day-today applications and get a glimpse of research.

- The students graduating in B.Sc. Agricultural Microbiology degree must have thorough understanding the fundamentals of Microbiology and Agricultural Microbiology as applicable to wide ranging contexts.
- They should have the appropriate skills of Agricultural Microbiology so as to perform their duties as agriculturists.
- They must be able to analyze the problems related to Agricultural Microbiology and come up with most suitable solutions.
- As Agricultural Microbiology is an interdisciplinary subject the students might have to take inputs from other areas of expertise. So, the students must develop the spirit of team work.

PROGRAM SPECIFIC OBJECTIVES [PSOB]: Programme Specific Objectives for B.Sc. Agricultural Microbiology are as follows:

- PSOB-1. The broad goal of the teaching to under graduate students in Agricultural Microbiology is to provide knowledge and skills in Microbiology and Agricultural Microbiology to develop practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research - based projects.
- PSOB-2. To learn basic concepts of amazing world of Microorganisms, Techniques in Microbiology, basics of Bacteriology, Cultivation, and growth of Micro-organisms.
- PSOB-3. To understand concepts of Soil Microbiology, Soil microbial Physiology, Fermentation Technology, Bacterial Genetics, Air, Water and Biogeochemical Transformations in soil.
- PSOB-4. To strengthen the fundamentals of various fields of Microbiology.
- PSOB-5.To develop scientific aptitude and motivate students to take up higher studies like B. Sc. (Hons. / Hons. with Research) microbiology and Research.
- PSOB-6. To realize and appreciate the applicability of knowledge and Interdisciplinary approach in everyday life.
- PSOB-7. The graduate students of Agricultural microbiology should have basic skills such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc.

PROGRAMME SPECIFIC OUTCOMES [PSOC]: Programme specific outcomes for B.Sc. Agricultural Microbiology are as follows:

- PSOC-1. The student will be able to explain various fields of Applied Science including Medicine, Pharmacy, Cell biology, Biotechnology, Industrial Production, Biochemistry, Nanotechnology, Environmental Management, Food, Dairy, Immunology, Agriculture and Bio-informatics.
- PSOC-2. The students will be able to design and execute experiments related to Basic Microbiology,Soil Microbiology, Molecular Biology, recombinant DNA Technology, and Microbial Genetics, etc.
- PSOC-3. The students will be able to execute a short research project incorporating techniques of Basic and Advanced Microbiology under supervision.
- PSOC-4. The students will be able to acquire sound knowledge of classification, taxonomy, structure , types of microorganisms and various fields of microbiology.

- PSOC-5. The students will be able to do experiment in microbiology laboratory to identify the microorganisms in various samples including clinical, environmental, water and food samples.
- PSOC-6. The students will be able to acquire knowledge about various diseases thereby can create awareness to the public.
- PSOC-7. The students will be able to provide knowledge on food processing, and fermented food products.
- PSOC-8. The students will be able to utilize various agricultural waste, marine sources as raw material for production of various fermented products to reduce accumulation of waste in the environment.
- PSOC-9. The students will be able to check the quality of water, dairy and food products by various learnt microbiological techniques
- PSOC-10. The students will be able to provide knowledge about history of Microbiology and contribution of various scientists. branches of Microbiology, basic structure of organism in details, microbial nutrition requirement for organism and microbial growth, microbiological techniques and control, different type of staining techniques used to distinguish between different type of bacteria and its organelles.
- PSOC-11. The students will be able to acquire knowledge about the different types of bacteria and viruses, microbial interaction, prevention of food from spoilage, preservation of food from food borne disease and food standards. also study the testing and preservation of milk and milk product in dairy industries.
- PSOC-12. The students will be able to acquire knowledge about the basic structure like Nucleic acid, carbohydrates metabolism, amino acids, enzymology in details and various vitamins. also study the fermentation at industrial level and upstream and downstream processing of fermentation.
- PSOC-13. The students will be able to acquire knowledge about different types of metabolic pathways and its regulation related to carbohydrates amino acid. also study about different type of waste water treatment methods and water testing methods. this also cover air and agricultural microbiology with bioremediation and biomagnification.
- PSOC -14. The students will be able to acquire knowledge about the epidemiology and host parasites, disease transmitted and their various sources, control and prevention & spreading of infection, learn about normal flora present in body, study of pathogenic and non-pathogenic organism, morphology, cultural and biochemicals characteristic, pathogenesis, serology test and lab diagnosis, gene mutation and regulation of gene.
- PSOC-15. The students will be able to acquire knowledge about Immunity, various defense mechanism, organs of immune system, adaptive immunity, and cell mediated immune response. tools and techniques of genetic engineering. also come to know about health care, agriculture, and industrial biotechnology.
- PSOC-16 The students will be able to Explain why microorganisms are ubiquitous in nature; inhabiting a multitude of habitats and occupying a wide range of ecological habitats, their role in these ecological niches, influence of microbiome on our health, environmental cleanup, variety of industrial product development, and their significance in human wellbeing.
- PSOC-17. The students will be competent enough to use microbiology knowledge and skills to analyze problems involving microbes, learning use of microbes as a model

organisms to understand facts about living systems, analyze the genetic makeup of different types understand of microbes, articulate these with peers/ team members/ other stake holders through effective communication, and undertake remedial measures/ studies etc.

- PSOC-18. The students will take up a suitable position in academia or industry and to pursue a career in research.
- PSOC-19. The students will be able to develop their skills to start small scale business in various microbiological laboratories and in the field of research and health.

Dr. Santosh M. More
Chairman,
Board of Studies of the Microbiology
Swami Ramanand Teerth Marathwada University,
Nanded

Details of the Board of Studies Members in the subject Microbiology under the faculty of Science & Technology of S. R. T. M. University, Nanded

Sr No	Name of the Member	Designation	Address	Contact No.
1.	**Dr. Santosh M. More**	**Professor & BOS, Chairman**	**Yeshwant Mahavidyalaya, Nanded**	**9422871533**
2.	**Dr. Rajendraprasad S. Awasthi**	**Principal**	**Shivaji Mahavidyalaya, Renapur**	**8275924462**
3.	**Dr. Prashant Wakte**	**Professor**	**DSM's College of Arts, Commerce and Science, Parbhani**	**8669062962**
4.	**Dr. Anupama P. Pathak**	**Professor**	**School of Life Sciences, SRTM University Nanded**	**9404732162**
5.	**Dr. Shiva C. Aithal**	**Professor**	**DSM's College of Arts, Commerce and Science, Parbhani**	**7483715560**
6.	**Dr. Deepak Vedpathak**	**Professor**	**Rajarshi Shahu Mahavidyalaya, Latur**	**9822757890**
7.	**Dr. Sanjivkumar V. Kshirsagar**	**Assistant Professor**	**Sant Janabai Education Society's ACS College, Gangakhed**	**9421448741**
8.	**Dr. Hemlata J. Bhosle**	**Associate Professor**	**School of Life Sciences, SRTM University Nanded**	**8698809434**
9.	**Dr. Sunita Mukkawar**	**Associate Professor**	**B. Raghunath ACS College, Parbhani**	**9422415911**
10.	**Dr. Ravindra R. Rakh**	**Associate Professor**	**Shri Guru Buddhiswami Mahavidyalaya, Purna**	**9545335680**
11.	**Dr. Prashant P. Dixit**	**Associate Professor**	**Dr. B.A.M. Uni. Aurangabad, Sub-camps, Osmanabad**	**9421335704**
12.	**Dr. M. K. Ranjekar**		**Green Vitlas Biotech, Ranje Village, Pune**	**9422015217**
13.	**Dr. Prita S. Borkar**	**Associate Professor**	**Science College, Nanded**	**9921121194**
14.	**Dr. Abhay B. Solunke**	**Associate Professor**	**Shri Govindrao Munghate Arts & Science College, Kurkheda, Gadchiroli**	**9403579999**
15.	**Dr. M. S. Dharne**	**Principal Scientist**	**National Collection of Industrial Microorganisms, CSIR- NCL, Pune**	**9730257991**

B. Sc. Second Year Semester III *(Level 5.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SAGMCT1201	Applied Microbiology	02	--	**08**	02	--
	SAGMCP1201	Practicals based on Paper SAGMCT1201	--	02			04
	SAGMCT1202	Microbes in Agriculture	02	--		02	--
	SAGMCP1202	Practicals based on Paper SAGMCT1202	--	02			04
Minor	SAGMMT1201	Soil Microbiology	02	-	**04**	02	--
	SAGMMP1201	Practicals based on Paper SAGMMT1201	--	02		--	04
Generic Electives *(from other Faculty)*	SAGMGE1201	Agricultural Applications of Microbes **(Basket 3 of respective Faculty)**	02	--	**02**	02	--
Skill Based Course (related to Major)	SAGMVC1201	Microbial Biofertilizers and Bioinsecticides	--	02	**02**	--	04
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	02	--	**02**	02	--
Ability Enhancement Course	AECMIL1201	(MAR/HIN/URD /KAN/PAL)	02	--	**02**	02	--
Community Engagement Services (CES)	CCCXXX1201	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	-	02	**02**	--	04
Total Credits			**12**	**10**	**22**	**12**	**20**

B. Sc. Second Year Semester III *(Level 5.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SAGMCT1201	Applied Microbiology	10	10	10	40	--	--	50
	SAGMCP1201	Practicals based on Paper SAGMCT1201	--	--	--	--	20	30	50
	SAGMCT1202	Microbes in Agriculture	10	10	10	40	--	--	50
	SAGMCP1202	Practicals based on Paper SAGMCT1202	--	--	--	--	20	30	50
Minor	SAGMMT1201	Soil Microbiology	10	10	10	40	--	--	50
	SAGMMP1201	Practicals based on Paper SAGMMT1201	--	--	--	--	20	30	50
Generic Electives *(from other Faculty)*	SAGMGE1201	Agricultural Applications of Microbes **(Basket 3 of respective Faculty)**	10	10	10	40	--	--	50
Skill Based Course (related to Major)	SAGMSC1201	Microbial Biofertilizers and Bioinsecticides	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1201	L1 – Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course	AECMIL1201	(MAR/HIN/URD /KAN/PAL)	10	10	10	40	--	--	50
Community Engagement Services (CES)	CCCXXX1201	Any one of NCC/ NSS /Sports/ Culture /Health Wellness /Yoga Education / Fitness **(Basket 6)**	--	--	--	--	20	30	50

B. Sc. Second Year Semester IV *(Level 5.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SAGMCT1251	Fundamentals of Microbial Biochemistry	02	--	**08**	02	--
	SAGMCP1251	Practicals based on Paper SAGMCT1251	-	02			04
	SAGMCT1252	Microbial Metabolism	02	--		02	--
	SAGMCP1252	Practicals based on Paper SAGMCT1252	-	02			04
Minor	SAGMMT1251	Food and Diary Microbiology	02	--	**04**	02	--
	SAGMMP1251	Practicals based on Paper SAGMMT1251	-	02			04
Generic Electives *(from other Faculty)*	SAGMGE1251	Soil Health management	02	--	**02**	02	--
Skill Based Course (related to Major)	SAGMVC1251	Microbial Laboratory Techniques	--	02	**02**	--	04
Ability Enhancement Course	AECENG12251	L1 – Compulsory English	02	--	**02**	02	--
Ability Enhancement Course	AECMIL1251	(MAR/HIN/URD /KAN/PAL)	02	--	**02**	02	--
Value Education Courses (VES)	EVS1251	Environmental Studies	02	--	**02**	--	04
Total Credits			**14**	**08**	**22**	**12**	**20**

B. Sc. Second Year Semester IV *(Level 5.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SAGMCT1251	Fundamentals of Microbial Biochemistry	10	10	10	40	--	--	50
	SAGMCP1251	Practicals based on Paper SAGMCT1251	--	--	--	--	20	30	50
	SAGMCT1252	Microbial Metabolism	10	10	10	40	--	--	50
	SAGMCP1252	Practicals based on Paper SAGMCT1252	--	--	--	--	20	30	50
Minor	SAGMMT1251	Food and Diary Microbiology	10	10	10	40	--	--	50
	SAGMMP1251	Practicals based on Paper SAGMMT1251	--	--	--	--	20	30	50
Generic Electives *(from other Faculty)*	SAGMGE1251	Soil Health Management	10	10	10	40	--	--	50
Skill Based Course (related to Major)	SAGMVC1251	Microbial Laboratory Techniques	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG12251	L1 – Compulsory English	10	10	10	40	--	--	50
Ability Enhancement Course	AECMIL1251	(MAR/HIN/URD /KAN/PAL)	10	10	10	40	--	--	50
Value Education Courses (VES)	EVS1251	Environmental Studies	10	10	10	40	--	--	50

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCT1201	Applied Microbiology	02	--	02	--	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCT1201	Applied Microbiology	10	10	10	40	--	--	50

SAGMCT1201: *Applied Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Theory Course: Agricultural Microbiology

Course Name: Applied Microbiology

Course Code: SAGMCT1201

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Agricultural Microbiology at undergraduate first year level, for entry level core courses in Agricultural Microbiology as Major subject.

Course objectives:

1. To understand the microbial diversity and ecology of air and water environments.
2. To study the transmission of airborne and waterborne diseases caused by microorganisms.
3. To learn methods for the microbiological analysis of air and water samples.
4. To explore the role of microbes in water purification, bioremediation, and wastewater treatment.
5. To develop practical skills in sampling, culturing, and identification of airborne and waterborne microorganisms

Course outcomes:

Upon successful completion of the course, students will be able to:

1. Explain the types, distribution, and survival mechanisms of microorganisms in air and water.
2. Describe airborne and waterborne microbial transmission and their impact on human health.
3. Perform air and water sampling techniques for microbial analysis.
4. Analyze and interpret water quality parameters (BOD, COD, MPN, etc.).
5. Identify microorganisms using staining, biochemical, and molecular techniques.
6. Understand the role of microorganisms in wastewater treatment and pollution control.
7. Evaluate the efficacy of air and water disinfection techniques

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Air Microbiology**	**08**
	1.1	Definition and Scope of Air Microbiology	
	1.2	Sources and Types of Microorganisms in Air	
	1.3	Microbiological Analysis of Air: i) Passive Sampling Method ii) Active Sampling Method	
	1.4	Airborne Microbial Diseases and Pathogens	
	1.5	Control Measures for Airborne Microbes: Physical Method and Chemical Method	
2.0	II	**Water Microbiology**	**08**
	2.1	Definition and Scope of Water Microbiology	
	2.2	Types of water; Sources of microorganisms in water	
	2.3	Index of Water Pollution; Indicator microorganisms for water quality: Total coliforms, Fecal coliforms, *Escherichia coli*, *Enterococci*, *Clostridium perfringens*	
	2.4	Microbial examination of Water: The Most Probable Number of Coliform (MPN); Standard Plate Count (SPC) and Membrane Filter Technique	
	2.5	Waterborne diseases and pathogens	
	2.6	Purification of Water: Sedimentation, Filtration, and Disinfection; Drinking water standards (WHO, BIS, and EPA guidelines)	

3.0	III	**Sewage Microbiology**	**07**
	3.1	Definition of Sewage and scope of Sewage Microbiology	
	3.2	Composition and strength of Sewage (BOD and COD)	
	3.3	Domestic Sewage Treatment	
	3.4	Municipal Sewage Treatment: Primary, secondary, Tertiary sewage treatment, and Composting	
	3.5	Pathogens in Sewage and Public Health Risks	
	3.6	Environmental Impact of Sewage Disposal	
4.0	IV	**Bioremediation of Air, Water and Sewage pollutants**	**07**
	4.1	Principles of Bioremediation	
	4.2	Bioremediation of Air Pollutants	
	4.3	Bioremediation of Water Contaminants	
	4.4	Bioremediation of Sewage	
	4.5	Future prospectus in Bioremediation	
		Total	**30**

Text books:

1. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
2. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay.

Reference Books:

1. Air Microbiology by S. C. Aithal, P. S. Wakte and A. V. Manwar, Cinnamon Teal Publishing
2. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
3. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.
4. Environmental Microbiology 2nd Edition by Raina M. Maier, Ian L. Pepper and Charles P. Gerba. Academic Press is an imprint of Elsevier (2009).
5. Wastewater Microbiology Third Edition by Gabriel Bitton, A John Wiley & Sons, Inc., Publication
6. Air Microbiology-An Environment and Health Perspective (2010) by Dr. Shiva C. Aithal, Dr. Anand V. Manwar and Dr. Prashant S. Wakte. Published by Cinnamonteal Print and Publishing, Dogears Print Media Pvt. Ltd. Edition 1st, Year of Publication: 2010. ISBN [978-93-80151-30-4]. (Hard Bound edition in 241 pages).
7. Water microbiology ~ an Indian perspective (2015) By Dr. Shiva C. Aithal and Dr. Nikhilesh S. Kulkarni. Published by Himalaya Publishing House, Book Edition: 1st, Year of Publication: 2015. ISBN No.: 978-93-5202-129-1 (Paper Back Edition in 254 Pages).

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCP1201	Practicals based on Paper SAGMCT1201	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCP1201	Practicals based on Paper SAGMCT1201	--	--	--	--	20	30	50

SAGMCP1201: *Practicals based on Paper SAGMCT1201*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Practical Course: Agricultural Microbiology

Course Name: Practicals based on Course SMICCT1201

Course Code :SAGMCP1201

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Agricultural Microbiology as Major subject.

Course Objectives:

1. To provide hands-on experience in air sampling techniques for microbiological analysis.
2. To familiarize students with methods for the enumeration and identification of airborne microorganisms.
3. To study the effect of environmental factors on the microbial composition of air.
4. To understand bioaerosol transmission and assess microbial contamination in different environments.
5. To develop skills in applying air microbiology techniques for public health and industrial applications.
6. To develop practical skills for microbiological examination of water and wastewater.
7. To train students in detecting microbial indicators of water pollution and pathogens.
8. To apply standard techniques for microbial enumeration, isolation, and identification in water and sewage.
9. To equip students with laboratory skills required for water quality monitoring and public health microbiology.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Demonstrate proficiency in air sampling techniques such as settle plate, impingement, and filtration methods.
2. Enumerate and identify airborne bacteria, fungi, and actinomycetes from different environments.
3. Evaluate the effect of environmental factors on airborne microbial populations.
4. Analyze bioaerosols and assess their potential health risks.
5. Apply microbiological techniques for monitoring and controlling microbial contamination in air.
6. Perform standard microbiological tests for water quality assessment, including MPN (Most Probable Number) and membrane filtration techniques.
7. Isolate and identify coliform bacteria and other microbial indicators of water pollution.
8. Analyze the efficiency of different water purification methods such as chlorination and filtration.
9. Examine the microbial composition of sewage and assess treatment efficiency through BOD and COD analysis.
10. Apply microbiological techniques for monitoring and improving water and wastewater quality.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Microbiological Analysis of Air**	**12 [3 Practicals]**
	1.1	Quantitative Assessment of Airborne Microorganisms using Settle Plate Method	
	1.2	Quantitative estimation of microbial load in air using air samplers	
	1.3	Identification of common fungal spores in air samples	
2.0	II	**Microbiological Analysis of Water**	**32 [8 Practicals]**
	2.1	Qualitative Analysis of water: Presumptive, Confirmatory and Completed tests	
	2.2	Isolation and identification of Indicator of water Pollution (*E. coli*)	

	2.3	Microbiological analysis of drinking water using MPN (Most Probable Number) method	
	2.4	Detection of coliform bacteria in water by membrane filtration technique	
	2.5	Method for detection of Enterococci from Packaged Drinking Water	
3.0	III	**Sewage Water Analysis**	**8 [2 Practicals]**
	3.1	Determination of Biological Oxygen Demand (BOD) of water	
	3.2	Determination of Chemical Oxygen Demand of (COD) of water	
	3.3	Isolation of Microorganisms from sewage samples	
4.0	IV	**Isolation and Study of Microorganisms' Role in the Environment**	**8 [2 Practicals]**
	4.1	To study the ability of microorganisms to degrade and decolorize synthetic dyes commonly used in industries	
	4.2	Antimicrobial sensitivity testing of waterborne pathogens	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Burns, R.G. and Slater, J.H. (1982). Experimental Microbiology and Ecology. Blackwell Scientific Publications, USA.
4. Peppler, I.L. and Gerba, C.P. (2004). Environmental Microbiology – A Laboratory Manual. Academic Press. New York.
5. Gupte, S. (1995). Practical Microbiology. Jaypee Brothers Medical Publishers Pvt. Ltd.
6. Kannan, N. (2003). Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers. Panima Publishing Co., New Delhi.
7. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition. Himalaya Publishing House, Mumbai.
8. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad,
9. India, F. A. S. A. (2020). Food Safety and Standards Authority of India. First Amendment Regulation Related to Limit of Metal Contaminant, Aflatoxin and Mycotoxin.

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCT1202	Microbes in Agriculture	02	--	02	--	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCT1202	Microbes in Agriculture	10	10	10	40	--	--	50

SAGMCT1202: *Microbes in Agriculture*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Theory Course: Agricultural Microbiology

Course Name: Microbes in Agriculture

Course Code: SAGMCT1202

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Agricultural Microbiology at undergraduate first year level, for entry level core courses in Agricultural Microbiology as Major subject.

Course objectives:

The primary objectives of this practical course are:

1. Have developed a fair good knowledge and understanding of soil, diversity and distribution of microorganisms.
2. Have developed the skill to measure the R:S ratio of soil Its study enables students to gain in-depth knowledge about microbial existence in soil,
3. Their interactions in soil, and microbial influences on one another.
4. It helps to understand beneficial and harmful plant pathogens to combat plant diseases.
5. Also, the microorganisms play an important role in bio-transformation of elements in the soil which increases soil fertility, improves soil texture, water holding capacities and humus formation.

Course outcomes:

Upon successful completion of the course, students will be able to:

1. Explain the microbial existence in soil.
2. Describe microbial interactions in soil, and their influences on one another.
3. Understand beneficial and harmful plant pathogens to combat plant diseases.
4. Analyze important role of microorganisms in bio-transformation of elements in the soil.
5. Apply techniques which increases soil fertility, improves soil texture, water holding capacities and humus formation.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Microbial Interactions in Soil**	**08**
	1.1	Soil as a culture medium, Diversity and distribution of microorganisms in soil.	
	1.2	Brief account of microbial interactions: Definition with examples of symbiosis, Mutualism, synergism, commensalism, competition, amensalism, parasitism and predation.	
	1.3	Microbial associations in phytosphere, rhizosphere and spermosphere, Rhizosphere and non-rhizosphere microflora, R: S ratio,	
	1.4	Interactions between plant and rhizosphere flora- Plant growth promoting Rhizobacteria, Mycorrhiza; Organic matter decomposition –humus formation.	
2.0	II	**Biogeochemical Cycles**	**08**
	2.1	Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin.	
	2.2	Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction.	
	2.3	Phosphorus cycle: Phosphate immobilization and solubilisation.	

	2.4	Sulphur cycle: Microbes involved in sulphur Cycle; Other elemental cycles: Iron and Manganese	
3.0	III	**Methods in Study of Microbes**	**07**
	3.1	Isolation of Microorganisms: Isolation of Soil Bacteria by streak plate method, Isolation of Fungi, Algae, Cyanophages, Protozoa and Bacteriophages. Enrichment cultures, The Buried slide, Immersion plate and Tube Method	
	3.2	Direct microscopic examination of soil, Fluorescent staining, soil percolation techniques, Estimation of soil enzymes.	
	3.3	Molecular methods: DNA Hybridization technique, Amplified length Polymorphism (AFLP), Pulse Field Gel Electrophoresis (PFGE), Fluorescent tagging method	
4.0	IV	**Application of Microorganisms in Agriculture**	**07**
	4.1	Non symbiotic nitrogen fixating bacteria: *Azotobacter chroococchum, Azospirillum lipoferum.* Symbiotic nitrogen fixating bacteria: *Rhizobium leguminosarum, Rhizobium japonicum,* Nitrogen fixing Cyanobacteria: *Nostoc, Anabaena*	
	4.2	Phosphorus solubilising bacteria: *Bacillus megaterium, Pseudomonas putida;* Potash mobilizing bacteria: *Frateuria aurentia*.	
	4.3	Plant growth promoting rhizobacteria (PGPR): *Bacillus subtilis, Pseudomonas fluorescens.*	
	4.4	Biocontrol fungus: *Trichoderma viride.* Insecticide fungus: *Metarhizium anisopliae*	
		Total	**30**

Text books:

1. Martin Alexander, 1997. Introduction to Soil Microbiology.
2. Subbha Rao, M.S. 1995. Soil microorganisms and plant growth.
3. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.

Reference Books:

1. Atlas R.N. and Bartha. R. 1993. Microbial Ecology-Fundamentals and Applications, 3 ed.
2. Maier, Pepper and Gerba, 2000. Environmental Microbiology, Academic Press.
3. Martin Alexander, 1997. Introduction to Soil Microbiology.
4. Subbha Rao, M.S. 1995. Soil microorganisms and plant growth.
5. Dubey. R.C. and Maheswari. D.K. A Textbook of Microbiology, 1999. 1 ed.
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA.
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
10. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
11. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
12. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
13. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCP1202	Practicals based on Paper SAGMCT1202	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCP1202	Practicals based on Paper SAGMCT1202	--	--	--	--	20	30	50

SAGMCP1202: *Practicals based on Paper SAGMCT1202*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Practical Course: Agricultural Microbiology

Course Name: Practicals based on Course SAGMCT1202

Course Code: SAGMCP1202

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Major subject.

Course Objectives:

The primary objectives of this practical course are:

1. Have developed a fair good knowledge and understanding of soil, diversity and distribution of microorganisms.
2. Have developed the skill to measure the R:S ratio of soil Its study enables students to gain in-depth knowledge about microbial existence in soil,
3. Their interactions in soil, and microbial influences on one another.
4. It helps to understand beneficial and harmful plant pathogens to combat plant diseases.
5. Also, the microorganisms play an important role in bio-transformation of elements in the soil which increases soil fertility, improves soil texture, water holding capacities and humus formation.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Explain the microbial existence in soil.
2. Describe microbial interactions in soil, and their influences on one another.
3. Understand beneficial and harmful plant pathogens to combat plant diseases.
4. Analyze important role of microorganisms in bio-transformation of elements in the soil.
5. Apply techniques which increases soil fertility, improves soil texture, water holding capacities and humus formation.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Microbial Interactions in soil**	**16 [4 Practicals]**
	1.1	Isolation of fungi & bacteria from soil.	
	1.2	Isolation of microorganisms from rhizosphere, phytosphere and spermosphere	
	1.3	Determination of R: S ratio.	
	1.4	Demonstration of mycorrhizal association in soil.	
2.0	II	**Biogeochemical Cycles**	**12 [3 Practicals]**
	2.1	Isolation of soil fungi associated with composting for cellulose and hemi cellulose degradation.	
	2.2	Demonstration of: i) Ammonification, ii) Nitrification, iii) Denitrification, iv) Nitrate reduction	
3.0	III	**Methods in Study of Microbes**	**20 [5 Practicals]**
	3.1	Isolation of soil bacteria by streak and pour plate methods	
	3.2	Isolation of soil microorganisms by buried slide method	
	3.3	Isolation of soil microorganisms by tube method	
	3.4	Isolation of protozoa by ring method	
	3.5	Direct microscopic examination of soil microorganisms	

4.0	IV	**Microorganisms for Agriculture use**	**12 [3 Practicals]**
	4.1	Isolation & study of *Rhizobium sp.* from root nodules of leguminous plants.	
	4.2	Isolation & study of *Azotobacter sp.* from rhizosphere soil	
	4.3	Isolation of Phosphorus solubilising bacteria from soil.	
	4.4	Isolation of Biocontrol agent *Trichoderma viride* from soil.	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Burns, R.G. and Slater, J.H. (1982). Experimental Microbiology and Ecology. Blackwell Scientific Publications, USA.
4. Peppler, I.L. and Gerba, C.P. (2004). Environmental Microbiology – A Laboratory Manual. Academic Press. New York.
5. Gupte, S. (1995). Practical Microbiology. Jaypee Brothers Medical Publishers Pvt. Ltd.
6. Kannan, N. (2003). Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers. Panima Publishing Co., New Delhi.
7. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition. Himalaya Publishing House, Mumbai.
8. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
9. P. J. Mehta's Practical Medicine 20th edition. Published by DR. S. P. Mehta, 04, Peddar Road, Hari Bhavan, Mumbai – 400026.
10. Microbiology Practical Manual, 1st Edition-E-book By Amita Jain, Jyotsna Agarwal, Vimala Venkatesh · 2018, Elsevier India.

Course Structure: *Minor 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMMT1201	Soil Microbiology	02	--	02	--	02

Minor1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMMT1201	Soil Microbiology	10	10	10	40	--	--	50

SAGMMT1201: *Soil Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Minor Theory Course: Agricultural Microbiology

Course Name: Soil Microbiology

Course Code: SAGMMT1201

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Agricultural Microbiology at undergraduate first year level, for entry level core courses in Agricultural Microbiology as Minor subject.

Course Objectives:

1. To understand the microbial diversity and ecology of soil.
2. To study the soil profile and properties of soil.
3. To learn methods for the microbiological analysis of soil samples.
4. To explore the role of microbes in agriculture.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Explain the types, distribution, and survival mechanisms of microorganisms in soil.
2. Perform and study soil microorganisms by different methods.
3. Identify soil microorganisms using staining, biochemical, and molecular techniques.
4. Understand the role of microorganisms in agriculture.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Introduction to Soil Microbiology**	**07**
	1.1	Introduction to Soil Microbiology, Scope of Soil Microbiology	
	1.2	Formation of Soil and Soil Profile	
	1.3	Physical and Chemical properties of Soil	
	1.4	Types of microorganisms in the soil: Bacteria, Fungi, Viruses, Actinomycetes, Protozoa, Nematodes	
	1.5	Importance of soil microorganisms in agriculture	
2.0	II	**Methods of isolation of Soil Microorganisms**	**07**
	2.1	Microscopy: Light and Electron Microscope	
	2.2	Culturing methods: Streak Plate, Pour Plate, Spread plate	
	2.3	Fluorescent Antibodies: Immuno fluorescence method	
	2.4	Nucleic acid Hybridization and gene probing; PCR method	
3.0	III	**Factors affecting abundance of bacteria in soil**	**08**
	3.1	Environmental Factors affecting abundance of Bacteria in soil	
	3.2	Temperature	
	3.3	Soil reaction: Soil pH	
	3.4	Drought and Salinity	
	3.5	Nutrient deficiency	
	3.6	Anthropogenic influence; its effect and Pollution	
4.0	IV	**Effect of Animal Waste, Sewage, Pesticides and Detergents**	**08**

	4.1	Sources of Animal Wastes Mode of diffusion of Animal Wastes Agricultural Value of Animal Wastes Animal Waste as a source of Pollution	
	4.2	Sewage; Principles of Sewage treatment Health risk potential associated with untreated sewage disposal Agricultural benefit of treated sewage	
	4.4	Pesticides; types of pesticides Fates of pesticides in Soil Effect of pesticides on Soil microbes and Plants	
	4.5	Detergents: Classes of detergents, Mode of action Soil -Detergent interaction Fate of Detergents in soil	
		Total	**30**

Text books:

1. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
2. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay.

Reference Books:

1. Air Microbiology by S. C. Aithal, P. S. Wakte and A. V. Manwar, Cinnamon Teal Publishing
2. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
3. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.
4. Environmental Microbiology 2nd Edition by Raina M. Maier, Ian L. Pepper and Charles P. Gerba. Academic Press is an imprint of Elsevier (2009).
5. Wastewater Microbiology Third Edition by Gabriel Bitton, A JOHN WILEY & SONS, INC., PUBLICATION

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMMP1201	Practicals based on Paper SAGMMT1201	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMMP1201	Practicals based on Paper SAGMMT1201	--	--	--	--	20	30	50

SAGMMP1201: *Practicals based on Paper SAGMMT1201*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Minor Practical Course: Agricultural Microbiology

Course Name: Practicals based on Course SAGMMT1201

Course Code: SAGMMP1201

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Major subject.

Course Objectives:

The primary objectives of this practical course are:

1. Have developed a fair good knowledge and understanding of soil, diversity and distribution of microorganisms.
2. Have developed the skill to measure the R:S ratio of soil Its study enables students to gain in-depth knowledge about microbial existence in soil,
3. Their interactions in soil, and microbial influences on one another.
4. It helps to understand beneficial and harmful plant pathogens to combat plant diseases.
5. Also, the microorganisms play an important role in bio-transformation of elements in the soil which increases soil fertility, improves soil texture, water holding capacities and humus formation.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Explain the microbial existence in soil.
2. Describe microbial interactions in soil, and their influences on one another.
3. Understand beneficial and harmful plant pathogens to combat plant diseases.
4. Analyze important role of microorganisms in bio-transformation of elements in the soil.
5. Apply techniques which increases soil fertility, improves soil texture, water holding capacities and humus formation.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Microorganisms in soil and its Isolation**	**12 [3 Practicals]**
	1.1	Study of microorganisms in soil.	
	1.2	Study of microorganisms from rhizosphere, Non rhizosphere soil	
	1.3	Determination of R: S ratio.	
2.0	II	**Methods of Isolation of soil microbes**	**20 [5 Practicals]**
	2.1	Isolation of soil bacteria by streak and pour plate methods	
	2.2	Isolation of soil microorganisms by buried slide method	
	2.3	Isolation of soil microorganisms by tube method	
	2.4	Isolation of protozoa by ring method	
	2.5	Direct microscopic examination of soil microorganisms	
3.0	III	**Effect of Environmental factors on soil Microbes**	**12 [3 Practicals]**
	3.1	Effect of Temperature on soil microorganisms	
	3.2	Effect of pH on soil microorganisms	
	3.3	Effect of salinity on soil microorganisms	
4.0	IV	**Effect of Animal waste, Sewage, Detergents and Pesticides**	**16 [4 Practicals]**
	4.1	Study of effect of Detergent on soil microorganisms	

	4.2	Study of effect of Pesticides on soil microorganisms	
	4.3	Isolation of pesticide degrading bacteria from soil.	
	4.4	Preparation of Biofertilizer from animal waste	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Burns, R.G. and Slater, J.H. (1982). Experimental Microbiology and Ecology. Blackwell Scientific Publications, USA.
4. Peppler, I.L. and Gerba, C.P. (2004). Environmental Microbiology – A Laboratory Manual. Academic Press. New York.
5. Gupte, S. (1995). Practical Microbiology. Jaypee Brothers Medical Publishers Pvt. Ltd.
6. Kannan, N. (2003). Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers. Panima Publishing Co., New Delhi.
7. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition. Himalaya Publishing House, Mumbai.
8. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
9. P. J. Mehta's Practical Medicine 20th edition. Published by DR. S. P. Mehta, 04, Peddar Road, Hari Bhavan, Mumbai – 400026.
10. Microbiology Practical Manual, 1st Edition-E-book By Amita Jain, Jyotsna Agarwal, Vimala Venkatesh · 2018, Elsevier India.

Course Structure: *Generic Elective 3 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMGE1201	Agricultural Applications of Microbes	02	--	02	--	02

Generic Elective 3 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMGE1201	Agricultural Applications of Microbes	10	10	10	40	--	--	50

SAGMGE1201: *Agricultural Applications of Microbes*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Generic Elective Course: Agricultural Microbiology

Course Name: Agricultural Applications of Microbes

Course Code: SAGMGE1201

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Humanities, Faculty of Commerce and Management, Faculty of Interdisciplinary Studies who had completed at undergraduate first year level.

Course Objectives:

1. To introduce students to the fundamental concepts of agricultural microbiology, including the role of microorganisms in soil, plant health, and nutrient cycling.
2. To explore the diversity, morphology, and physiology of agriculturally important microorganisms, including bacteria, fungi, actinomycetes, and viruses.
3. To understand microbial interactions in the soil ecosystem and their impact on plant growth and disease management.
4. To study the applications of beneficial microorganisms in agriculture, such as biofertilizers, biopesticides, and plant growth-promoting rhizobacteria (PGPR).
5. To familiarize students with microbial techniques used in agricultural microbiology, including isolation, identification, and cultivation of soil and plant-associated microbes.
6. To highlight the significance of microbial biotechnology in sustainable agriculture and environmental protection.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Explain the fundamental principles of agricultural microbiology and the role of microorganisms in soil fertility and plant health.
2. Describe the characteristics, classification, and functions of agriculturally important microorganisms.
3. Analyze microbial interactions in soil ecosystems and their effects on plant growth and disease suppression.
4. Evaluate the applications of beneficial microbes in agriculture, including biofertilizers and biocontrol agents.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Introduction to Agricultural Microbiology**	**07**
	1.1	Definition, History, and Cope of Agricultural Microbiology	
	1.2	Importance of microorganisms in agriculture	
	1.3	Major groups of agriculturally important microbes: Bacteria, fungi, actinomycetes, viruses, and protozoa	
	1.4	Role of microorganisms in soil fertility and soil health	
	1.5	Biogeochemical cycles (Carbon, Nitrogen, Phosphorus, and Sulfur cycles)	
2.0	II	**Biofertilizers**	**07**
	2.1	Nitrogen-Fixing Microorganisms as Biofertilizers	
	2.2	Phosphate Solubilising Microorganisms as Biofertilizers	
	2.3	PGPB (Plant Growth Promoting Bacteria): Plant Growth Promoters	

3.0		**Biopesticides**	**08**
	3.1	Bioherbicides	
	3.2	Bioinsecticides	
	3.3	Biofungicides	
	3.4	Bionematicides	
4.0		**Microbial-Based Biorational Pesticides**	**08**
	4.1	Bacterial Secondary Metabolites as Agrochemicals	
	4.2	Agroactive Compounds from Actinomycetes	
	4.3	Fungal Secondary Metabolites as Agrochemical	
		Total	**30**

Text books:

1. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
2. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay.

Reference Books:

1. Applied Microbiology by Sanjai Saxena, Springer New Delhi Heidelberg New York Dordrecht London © Springer India 2015
2. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
3. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMVC1201	Microbial Biofertilizers & Bioinsecticides	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMVC1201	Microbial Biofertilizers & Bioinsecticides	--	--	--	--	20	30	50

SAGMVC1201: *Microbial Biofertilizers & Bioinsecticides*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Vocational Course: Agricultural Microbiology

Course Name: Microbial Biofertilizers and Bioinsecticides

Course Code: SAGMVSC1201

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Major subject.

Course Objectives:

1. To provide fundamental knowledge of biofertilizers and bioinsecticides, their types, and their role in sustainable agriculture.
2. To develop skills in the production, formulation, and application of biofertilizers and bioinsecticides.
3. To familiarize students with microbial strains used in biofertilizers and biopesticides and their mechanisms of action.
4. To train students in quality control, storage, and commercialization aspects of biofertilizers and bioinsecticides.
5. To promote eco-friendly agricultural practices and reduce dependency on chemical fertilizers and pesticides.
6. To equip students with entrepreneurship skills for self-employment in the bio-inputs industry.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Explain the concept, significance, and types of biofertilizers and bioinsecticides in sustainable agriculture.
2. Identify and describe the beneficial microorganisms used in biofertilizers (e.g., Rhizobium, Azotobacter, Azospirillum, PSB) and bioinsecticides (e.g., Bacillus thuringiensis, Beauveria bassiana).
3. Demonstrate skills in laboratory techniques for the isolation, mass production, and formulation of biofertilizers and bioinsecticides.
4. Apply biofertilizers and bioinsecticides effectively in agricultural fields and assess their impact on plant growth and pest control.
5. Evaluate the quality and efficacy of biofertilizer and bioinsecticide products as per regulatory standards.
6. Develop business plans and marketing strategies for setting up small-scale biofertilizer and bioinsecticide production units.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Commercial Production of *Azotobacter* Biofertilizer**	**12 [3 Practicals]**
	1.1	Isolation and Culture Maintenance of *Azotobacter spp.*	
	1.2	Mass Multiplication of *Azotobacter spp*	
	1.3	Formulation of *Azotobacter* Biofertilizer with Carrier Material	
	1.4	Packaging and Storage of *Azotobacter* Biofertilizer	
	1.5	Quality Control Tests for *Azotobacter* Biofertilizer	

2.0	II	**Commercial Production of *Rhizobium* Biofertilizer**	**16 [4 Practicals]**
	2.1	Isolation and Culture Maintenance of *Rhizobium spp.*	
	2.2	Mass Multiplication of *Rhizobium spp*	
	2.3	Formulation of *Rhizobium* Biofertilizer with Carrier Material	
	2.4	Packaging and Storage of *Rhizobium* Biofertilizer	
	2.5	Quality Control Tests for *Rhizobium* biofertilizers	
3.0	III	**Commercial Production of Phosphate Solubilizers**	**16 [4 Practicals]**
	3.1	Selection of Efficient PSM Strains	
	3.2	Mass Cultivation of PSMs	
	3.3	Formulation & Stabilization of PSMs	
	3.4	Packaging & Storage of PSMs	
	3.5	Quality Control & Shelf-Life Testing of PSMs	
4.0	IV	**Commercial Production of *Bacillus thuringienesis* as bioinsecticides**	**16 [4 Practicals]**
	4.1	Selection of Efficient Bt Strains	
	4.2	Bt Cultivation & Mass Production	
	4.3	Harvesting & Formulation	
	4.4	Packaging & Storage	
	4.5	Quality Control & Bioefficacy Testing	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Masso, C., AbdelGadir, A. A. H., Thuita, M. N., Tarus, D., Mitiku, G., Shimber, T., ... & Tumuhairwe, J. B. (2016). Training manual for product screening and inspection.
4. RECORD, P. M. C. *FACULTY OF AGRICULTURE* (Doctoral dissertation, Annamalai University).
5. Agarwal, S., Kumari, S., & Khan, S. (2021). Quality control of biofertilizers. Biofertilizers: Study and Impact, 413-428.
6. Biofertilizer Manual By FNCA Biofertilizer Project Group Forum for Nuclear Cooperation in Asia (FNCA) March 2006

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCT1251	Fundamentals of Microbial Biochemistry	02	--	02	--	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCT1251	Fundamentals of Microbial Biochemistry	10	10	10	40	--	--	50

SAGMCT1251: *Fundamentals of Microbial Biochemistry*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Theory Course: Agricultural Microbiology

Course Name: Fundamentals of Microbial Biochemistry

Course Code: SAGMCT1251

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Major subject.

Course Objectives:

1. To provide a comprehensive understanding of the classification, structure, and functions of biomolecules essential to microbial life.
2. To explore the biochemical properties of carbohydrates, lipids, proteins, nucleic acids, and their significance in microbial metabolism.
3. To analyze the role of fatty acids and lipids in cellular signaling, membrane structure, and energy metabolism.
4. To develop an understanding of enzyme structure, classification, catalytic mechanisms, and regulatory factors affecting enzyme activity.
5. To introduce the importance of nucleic acids in genetic information flow and their interactions with proteins.
6. To emphasize the role of vitamins in microbial metabolism and enzymatic functions.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Understand the classification and properties of carbohydrates, including monosaccharides, disaccharides, polysaccharides, and sugar derivatives.
2. Gain knowledge of lipids and fatty acids, including their classification, structures, functions, and their role in cell signaling and metabolism.
3. Comprehend the structure and functions of amino acids and proteins, including their primary, secondary, tertiary, and quaternary structures.
4. Learn about the structure and functions of nucleic acids, including DNA and RNA, as well as the concept of base composition and nucleic acid- protein interactions. They will also be introduced to the role of vitamins in metabolism.
5. Understand the structure of enzymes, enzyme classification, and mechanisms of action. They will also learn about the factors influencing enzyme activity and various types of enzyme inhibition.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Biomolecules – Carbohydrates**	**07**
	1.1	Definition, General properties and classification of carbohydrates	
	1.2	Monosaccharides- structure and function of aldoses and ketoses, trioses, tetroses, pentoses, and hexoses.	
	1.3	Oligosaccharides- concept of reducing and non-reducing sugars; Classification of Oligosaccharide, Glycosidic linkage; structure and function of Sucrose, Lactose and Maltose	
	1.4	Polysaccharides- Classification of Polysaccharide, Storage -Starch, glycogen, Structural-Cellulose, Peptidoglycan and Chitin; Detection of Carbohydrates	
	1.5	Biological Significance of carbohydrates	

2.0	II	**Informational and Functional Biomolecules – Amino Acids and Proteins**	
	2.1	Amino Acids: The Building Blocks of Proteins Definition, Structure, Classification and Properties of Amino Acids	**08**
	2.2	Separation of Amino Acids: Paper Chromatography and Paper Electrophoresis	
	2.3	Peptide bond; Primary, secondary, tertiary and quaternary structures of Protein	
	2.4	Detection of Protein: biuret test, Bradford test, bicinchoninic acid assay (BCA assay) and Lowry test.	
	2.5	Enzymes: Structure of enzyme, Apoenzyme and cofactors, prosthetic group-TPP, coenzyme -NAD, metal cofactors,	
	2.6	Human haemoglobin structure; Biological Significance of Proteins	
3.0	III	**Biomolecules – Lipids and fatty acids**	
	3.1	Definition and Classification of Lipids – Structural and Functional	**07**
		Building Blocks of Storage Lipids - Glycerol and Fatty Acid	
	3.2	Fatty acids: definition, structure, nomenclature and classification; Saturated and Unsaturated fatty acids; Essential and Nonessential Fatty Acids	
	3.3	Storage Lipids – structure, function of Triacylglycerides And structure, function of Waxes	
		Structural Lipids: Structure, function and Properties of phospholipids, glycolipids, and Cholesterol	
		Detection of Lipids and Fatty acids, Saponification	
	3.4	Biological Significance of Lipids	
4.0	IV	**Informational and Functional Biomolecules – RNA and DNA**	
	4.1	Chemical structure of DNA and RNA: Ribose and Deoxyribose sugars, Nitrogen bases, Nucleosides and Nucleotides Sugar-phosphate backbone, base pairing, hydrogen bonding	**08**
	4.2	Types of DNA: A-DNA, B-DNA, Z-DNA	
	4.3	DNA:- Properties, Structure and Functions	
	4.4	RNA:- Properties, Structure and Functions	
	4.5	Detection of DNA and RNA	
		Total	**30**

Text books:

1. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
2. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay

Reference Books:

1. Biochemistry 4th edition by U. Satyanarayana and U. Chakrapani, ELSEVIER.
2. Biochemistry 4th edition by DONALD VOET and JUDITH G. VOET, JOHN WILEY & SONS , INC. Publication. (2011).
3. Textbook of Biochemistry with Clinical Correlations Fourth Edition by Thomas M. Devlin. Wiley Liss, Inc. (1997).

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCP1251	Practicals based on Paper SAGMCT1251	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCP1251	Practicals based on Paper SAGMCT1251	--	--	--	--	20	30	50

SAGMCP1251: *Practicals based on Paper SAGMCT1251*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Practical Course: Agricultural Microbiology

Course Name: Practicals based on Course SAGMCT1251

Course Code: SAGMCP1251

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Major subject.

Course Objectives:

1. To develop hands-on skills in qualitative and quantitative analysis of biomolecules, including carbohydrates, proteins, lipids, and nucleic acids.
2. To familiarize students with different biochemical techniques used for detecting and estimating biomolecules.
3. To understand the structural and functional properties of carbohydrates, proteins, lipids, and nucleic acids through laboratory experiments.
4. To apply biochemical methods for the extraction, purification, and characterization of biomolecules from biological samples.
5. To enhance students' ability to interpret experimental data and relate biochemical principles to microbial physiology and metabolism.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Perform qualitative tests to detect different classes of carbohydrates, proteins, lipids, and nucleic acids in biological samples.
2. Conduct quantitative estimation of biomolecules using spectrophotometric and colorimetric methods.
3. Analyze the physicochemical properties of biomolecules through experimental techniques such as chromatography and electrophoresis.
4. Demonstrate proficiency in biomolecule extraction and purification methods.
5. Interpret experimental results and apply biochemical techniques to research and industrial applications.
6. Develop problem-solving skills and laboratory competence for biochemical assays used in microbiology and biotechnology.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Qualitative and Quantitative Analysis of Carbohydrate**	**24 [6 Practicals]**
	1.1	Molisch's Test; Anthrone test – General test for carbohydrates	
	1.2	Iodine Test – starch and glycans	
	1.3	Seliwanoff's test – Ketone	
	1.4	Benedict's and Barfoed's Test– reducing sugars	
	1.5	Bial's test – Pentose sugar	
	1.6	Quantitative estimation of reducing sugar by DNSA Method	
	1.7	Estimation of Reducing Sugar by Benedict's Method	
	1.8	Estimation of carbohydrate by the Anthrone method	
	1.9	Separation of Sugars by Paper Chromatography	

2.0	II	**Qualitative and Quantitative Analysis of Proteins**	**12 [3 Practicals]**
	2.1	Biuret test (for peptide bonds)	
	2.2	Ninhydrin reaction (Amino acids)	
	2.3	Xanthoproteic reaction (for Aromatic Amino Acids)	
	2.4	Aldehyde Test for Indole Nucleus (Hopkins-Cole's Test) – Tryptophan	
	2.5	Sakaguchi Test for Guanidine Group (Reaction of Arginine)	
	2.6	Test for Sulphur-containing Amino Acids (Cysteine or cystine)	
	2.7	Analysis of Individual Proteins: - Gelatin	
	2.8	Estimation of Protein by Lowrey's Method; Biuret reagent and Bradford Assay	
	2.9	Estimation of Proteins by UV Spectrophotometry at 280 nm	
	3.0	Precipitation of Proteins Using Salting Out Method (Ammonium Sulfate Precipitation); Separation of Amino Acids by Thin Layer Chromatography	
3.0	III	**Qualitative and Quantitative Analysis of lipids**	**12 [3 Practicals]**
	3.1	Qualitative Tests: Physical Test: Grease spot test, Test for free fatty acids; Emulsification; Saponification test; Tests for unsaturation of fatty acids;	
	3.2	Tests for Glycerol: Acrolein test; Dichromate Test	
	3.3	Qualitative Test of Cholesterol: Salkowski's Test; Formaldehyde-H_2SO_4 Test; Liebermann-Burchard Reaction (Acetic Anhydride Sulfuric Acid Test)	
	3.4	Quantitative Tests: Determination of Iodine Number	
	3.5	quantitative determination of the total lipid sulfo-phospho-vanillin colorimetric method	
	3.6	Estimation of Free Fatty Acid Value (FFA)	
4.0	IV	**Qualitative and Quantitative Analysis of DNA and RNA**	**12 [3 Practicals]**
	4.1	Qualitative analysis of DNA by Test for Deoxyribose (Dische test); Test for Phosphates; Test for Purines (Murexide Test); Test for Pyrimidines (Wheeler-Johnson Test)	
	4.2	Orcinol Test for Ribose (Specific for RNA); Bial's Orcinol Test for RNA Detection.	
	4.3	Estimation of RNA by Using Orcinol Method	
	4.4	Estimation of DNA by Diphenylamine Reaction	
	4.5	Estimation of DNA Concentration Using UV Spectrophotometry at 260 nm	
		Total	**60**

Reference Books:

1. Practical Biochemistry by Geetha Damodaran K. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi. (2011)
2. Practical Textbook of BIOCHEMISTRY for Medical Students by DM Vasudevan, and Subir Kumar Das, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi. (2013).
3. Practical Manual of Biochemistry by Sattanathan Govindharajan, Swaminathan Padmapriya and Balasubramanian Balamurali krishnan, Skyfox Publishing Group Skyfox Press. (2020).

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCT1252	Microbial Metabolism	02	--	02	--	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCT1252	Microbial Metabolism	10	10	10	40	--	--	50

SAGMCT1252: Microbial Metabolism

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Theory Course: Agricultural Microbiology

Course Name: Microbial Metabolism

Course Code: SAGMCT1252

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Agricultural Microbiology at undergraduate first year level, for entry level core courses in Agricultural Microbiology as Major subject.

Course objectives:

1. To provide knowledge about microbial diversity in broad sense in terms of metabolic processes
2. To enable students in understanding and differentiating phototrophs, lithotrophs, chemotrophs, heterotrophs, chemolithoautotrophs and chemoheterotrophs etc.
3. To acquire knowledge of aerobic respiration and associated mechanisms of energy generation
4. To understand which microorganisms uses different nutrients for growth and associated mechanisms of energy generation for their survival.

Course outcomes:

1. Upon successful completion of the course, students will be able to:
2. Gain knowledge about microbial diversity in broad sense in terms of metabolic processes
3. Has acquired understanding and differentiating phototrophs, lithotrophs, chemotrophs, heterotrophs,
4. chemolithoautotrophs and chemoheterotrophs etc.
5. Has acquired fair knowledge of aerobic respiration and associated mechanisms of energy generation.
6. microorganisms which uses different nutrient for growth and associated mechanisms of energy generation for their survival.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Phototrophic Metabolism**	**09**
	1.1	Concept of Phototrophy; Autotrophic CO_2 fixation and mechanism of photosynthesis	
	1.2	Difference between Oxygenic and anoxygenic photosynthesis; cyclic and noncyclic photophosphorylation	
	1.3	Photosynthetic pigments in prokaryotes; Photosynthesis in Cyanobacteria, Purple and Green Sulphur bacteria	
	1.4	Metabolism in nitrifying, Sulfur Bacteria and Iron Bacteria	
	1.5	Metabolism in Hydrogen Bacteria	
2.0	II	**Chemoheterotrophic Metabolism-Aerobic Respiration**	**09**
	2.1	Concept of aerobic respiration and ATP generation	
	2.2	Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle,	
	2.3	Electron transport chain: components of respiratory chain and Electron Transport Chain	

	2.4	Comparison of mitochondrial and bacterial ETC.	
3.0	III	**Chemoheterotrophic Metabolism - Anaerobic Respiration and inorganic metabolism**	**06**
	3.1	Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/nitrite and Nitrate)	
	3.2	Anaerobic respiration with special reference to ammonia respiration and Nitrate reduction	
	3.3	Methylotrophs and their types; pathway of oxidative reactions in methylotrophs and methane production in anaerobic conditions.	
	3.4	Methanogens; pathway for the reduction of CO_2 to methane	
4.0	IV	**Anaerobic Fermentation**	**06**
	4.1	Concept of Fermentation; Linear and branched fermentation pathways	
	4.2	Alcohol fermentation and Pasteur effect	
	4.3	Lactate fermentation (homolactic and heterolactic pathways)	
	4.4	Butyrate and Acetone butanol ethanol fermentations	
		Total	**30**

Text books:

1. Gottschalk, G. (1986). Bacterial Metabolism, Springer-Verlag, New-York.
2. Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications, Iowa, USA.
3. Moat, A.G. and Foster, J.W. (1995). Microbial Physiology, John-Wiley, New York.
4. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.
5. Reddy, S.R. and Reddy, S.M. (2004). Microbial Physiology, Scientific Publishers, Jodhpur, India.

Reference Books:

1. Sawhney, S.K. and Singh, R. (2000). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology. S. Chand & Co. Ltd., New Delhi.
3. Plummer, D.T. (1988). An Introduction to Practical Biochemistry. 3rd Edition, Tata Mc GrawHill, New Delhi.
4. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
5. Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
6. Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.
7. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, . Himalaya Publishing House, Mumbai.
8. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
9. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons .
10. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
11. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMCP1252	Practicals based on Paper SAGMCT1252	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMCP1252	Practicals based on Paper SAGMCT1252	--	--	--	--	20	30	50

SAGMCP1252: *Practicals based on Paper SAGMCT1252*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Practical Course: Agricultural Microbiology

Course Name: Practicals based on Course SAGMCT1252

Course Code: SAGMCP1252

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Agricultural Microbiology at undergraduate first year level, for entry level core courses in Agricultural Microbiology as Major subject.

Course Objectives:

1. To provide knowledge about microbial diversity in broad sense in terms of metabolic processes
2. To enable students in understanding and differentiating phototrophs, lithotrophs, chemotrophs, heterotrophs, chemolithoautotrophs and chemoheterotrophs etc.
3. To acquire knowledge of aerobic respiration and associated mechanisms of energy generation
4. To understand which microorganisms uses different nutrients for growth and associated mechanisms of energy generation for their survival.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Gain practical knowledge about microbial diversity in broad sense in terms of metabolic processes
2. Has acquired understanding and differentiating phototrophs, lithotrophs, chemotrophs, heterotrophs, chemolithoautotrophs and chemoheterotrophs etc.
3. Has acquired knowledge about culturing of phototrophs and chemotrophic bacteria
4. Has acquired practical knowledge of different types of fermentations.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Isolation of phototrophs and chemoheterotrophs**	**32 [8 Practicals]**
	1.1	Enrichment, culturing and isolation of phototrophs.	
	1.2	Enrichment, culturing and isolation of chemoautotrophs Study of Cyanobacteria- *Nostoc*	
	1.3	Enrichment, culturing and isolation of chemoautotrophs Study of Cyanobacteria- *Anabaena*	
	1.4	Preparation of media for culturing autotrophic and heterotrophic microorganisms	
	1.5	Laboratory experiments on demonstration of: i) Ammonification	
	1.6	Laboratory experiments on demonstration of: ii) Nitrification and iii)Denitrification	
	1.7	Laboratory experiments on demonstration of: iv) Nitrate reduction	
	1.8	Laboratory experiments on demonstration of: v) Sulfate reduction	

2.0	II	**Microbial Metabolism**	**8 [2Practicals]**
	2.1	Demonstration of Glycolysis and EMP	
	2.2	Demonstration of HMP and ED	
	2.3	Demonstration of ETC in bacteria	
	2.4	Methane production by anaerobic conditions.	
3.0	III	**Citric acid fermentation**	**8 [2 Practicals]**
	3.1	Citric acid fermentation & Extraction of Citric acid	
	3.2	Estimation of citric acid by titrimetric method.	
4.0	IV	**Study of Fermentations**	**12 [3 Practicals]**
	4.1	Alcoholic fermentation by *Saccharomyces cerevisiae.*	
	4.2	Lactic acid fermentation.	
	4.3	Acetone butanol fermentation.	
		Total	**60**

Reference Books:

1. Wilson, K. and Walker, J. (1994). Practical Biochemistry. 4th Edition, Cambridge University Press, England.
2. Sawhney, S.K. and Singh, R. (2000). Introductory Practical Biochemistry, Narosa Publishing House, New Delhi.
3. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology. S. Chand & Co. Ltd., New Delhi.
4. Plummer, D.T. (1988). An Introduction to Practical Biochemistry. 3rd Edition, Tata Mc GrawHill, New Delhi.
5. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
6. P. J. Mehta's Practical Medicine 20th edition. Published by DR. S. P. Mehta, 04, Peddar Road, Hari Bhavan, Mumbai – 400026.

Course Structure: *Minor 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMMT1251	Food and Diary Microbiology	02	--	02	--	02

Minor1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMMT1251	Food and Diary Microbiology	10	10	10	40	--	--	50

SAGMMT1251: *Food and Diary Microbiology*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Minor Theory Course: Agricultural Microbiology

Course Name: Food and Diary Microbiology

Course Code: SAGMMT1251

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Minor subject.

Course Objectives:

1. To provide fundamental knowledge of microorganisms associated with food and dairy products, their roles, and their impact on food quality and safety.
2. To understand the principles of food and dairy microbiology, including microbial growth, metabolism, and factors influencing microbial survival in food.
3. To study the role of beneficial microbes in food fermentation, preservation, and probiotics.
4. To learn about foodborne pathogens, spoilage microorganisms, and methods for their detection, prevention, and control.
5. To familiarize students with microbiological techniques used in food and dairy industries for quality assurance and safety assessment.
6. To provide practical knowledge of microbiological analysis of food and dairy products, including microbial enumeration and identification techniques.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Describe the types of microorganisms found in food and dairy products and their significance in food microbiology.
2. Explain the factors affecting microbial growth in food, including intrinsic, extrinsic, and processing parameters.
3. Analyze the roles of microorganisms in food fermentation and their applications in the food and dairy industry.
4. Identify common foodborne pathogens, spoilage organisms, and their mechanisms of contamination and disease transmission.
5. Apply microbiological techniques for the enumeration, isolation, and identification of food-associated microorganisms.
6. Evaluate methods for food preservation, including thermal processing, refrigeration, chemical preservatives, and biopreservation.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Introduction to Food and Dairy Microbiology**	**07**
	1.1	Historical developments in food microbiology	
	1.2	Scope and significance of food and dairy microbiology	
	1.3	Sources of contamination in food and dairy	
	1.4	Types of microorganisms in food and dairy products	
	1.5	Factors affecting microbial growth in food	
2.0	II	**Microbial Spoilage of Food and Dairy Products**	**07**
	2.1	Microbial Spoilage of Food: Causes of soilage, Biochemical changes caused by microbes, spoilage canned foods	

	2.2	Microbial spoilage of Dairy products: Causes of soilage, Biochemical changes caused by microbes	
	2.3	Spoilage indicators of Food and Dairy products: color, smell, taste, or texture	
	2.4	Importance of Microorganisms in Food and dairy products	
	2.5	Microbiological Analysis of Food and dairy Products: SPC, DMC, MBRT and Phosphatase test	
3.0	III	**Food Preservation Techniques**	
	3.1	Physical methods: Heat treatment (pasteurization, sterilization, UHT), drying, cold storage	**08**
	3.2	Chemical methods: Use of preservatives (common salt, sugar, dextrose (glucose), spices, vinegar or acetic acid, honey, and vegetable oils. nitrites, sulphites, antibiotics)	
	3.3	Biological preservation: Bacteriocins, probiotics, and biopreservation	
4.0	IV	**Fermented Foods and Food Borne Diseases**	
	4.1	Fermented foods: Idly, bread	
	4.2	Fermented dairy products: whey, yogurt, butter and cheese	**08**
	4.4	Food Borne Diseases: Food intoxications: Staphylococcus aureus, and mycotoxins. Food infections: Gastroenteritis (*Bacillus cereus*, *Escherichia coli*), dysentery (Shigella) Salmonellosis	
		Total	**30**

Text books:

1. Dubey R.C. and D. K, Maheshwari, A textbook of Microbiology 5th edition, S Chand and Co. New Delhi. (2022)
2. Powar C. B. and Daginawala H.I., General microbiology Vol I and II by Himalaya publishing house, Bombay.

Reference Books:

1. Air Microbiology by S. C. Aithal, P. S. Wakte and A. V. Manwar, Cinnamon Teal Publishing
2. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
3. A laboratory Manual for undergraduates in Agricultural Microbiology, Microbiology and Biotechnology by Prita Shamrao Borkar, ISBN: 978-93-91768-69-0, https://www.bhumipublishing.com/books/
4. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.
5. Environmental Microbiology 2nd Edition by Raina M. Maier, Ian L. Pepper and Charles P. Gerba. Academic Press is an imprint of Elsevier (2009).
6. Wastewater Microbiology Third Edition by Gabriel Bitton, A JOHN WILEY & SONS, INC., PUBLICATION

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMMP1251	Practicals based on Paper SAGMMT1251	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMMP1251	Practicals based on Paper SAGMMT1251	--	--	--	--	20	30	50

SAGMMP1251: *Practicals based on Paper SAGMMT1251*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Minor Practical Course: Agricultural Microbiology

Course Name: Practicals based on Course SAGMMT1251

Course Code: SAGMMP1251

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Minor subject.

Course Objectives:

1. To develop practical skills in handling and analyzing food and dairy samples for microbiological quality and safety.
2. To familiarize students with microbial enumeration, isolation, and identification techniques used in food and dairy industries.
3. To study the microbial spoilage of different food and dairy products through laboratory techniques.
4. To assess the effectiveness of food preservation methods and antimicrobial agents.
5. To perform microbiological quality control tests in accordance with food safety standards.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Demonstrate aseptic techniques and standard microbiological procedures for handling food and dairy samples.
2. Perform total viable count (TVC), yeast and mold count, and other enumeration methods for microbial analysis of food.
3. Isolate and identify foodborne pathogens (e.g., Salmonella, E. coli, Staphylococcus) from contaminated food samples.
4. Analyze the microbial quality of milk and dairy products using MBRT, phosphatase, and coliform tests.
5. Evaluate the microbial spoilage of perishable food items like bread, meat, fruits, and vegetables.
6. Assess the antimicrobial effects of food preservatives and natural antimicrobial agents on microbial growth.
7. Prepare and examine fermented food products, isolating beneficial microbes involved in fermentation.
8. Detect food adulterants and contaminants using microbiological and biochemical tests.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Microbiological Analysis of Food**	**24 [6 Practicals]**
	1.1	Direct Microscopic Count (DMC) of Bread/Chapati	
	1.2	Standard Plate Count (SPC) of Bread/Chapati	
	1.3	Isolation, identification and enumeration of *S. aureus* and *Bacillus Cereus* from food	
2.0	II	**Microbiological Analysis of Milk**	**16 [4 Practicals]**
	2.1	Direct Microscopic Count (DMC)	
	2.2	Standard Plate Count (SPC)	
	2.3	Methylene Blue Reduction Test (MBRT)	
	2.4	Phosphatase Test	
3.0	III	**Basic Tests for Milk Analysis**	
	3.1	Taste Flavour and Appearance; Milk pH; Alcohol Test	

	3.2	Presence of Additives: Starch: Iodine test; Soda: Rosalic acid test; Sugar: Resorcinol test; Urea: Dimethyl amino benzaldehyde test	**8 [2 Practicals]**
4.0	IV	**Detection and Enumeration of Spoilage Micro-organisms**	**12 [3 Practicals]**
	4.1	Psychrotrophic Count	
	4.2	Lipolytic Count	
	4.3	Proteolytic Count	
	4.4	Pectinolytic Count	
	4.5	Halophilic Count	
	4.6	Acidophilic Count	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2002). Practical Microbiology, S. Chand & Co., New Delhi.
3. Burns, R.G. and Slater, J.H. (1982). Experimental Microbiology and Ecology. Blackwell Scientific Publications, USA.
4. Peppler, I.L. and Gerba, C.P. (2004). Environmental Microbiology – A Laboratory Manual. Academic Press. New York.
5. Gupte, S. (1995). Practical Microbiology. Jaypee Brothers Medical Publishers Pvt. Ltd.
6. Kannan, N. (2003). Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers. Panima Publishing Co., New Delhi.
7. Gopal Reddy, M., Reddy, M.N., Saigopal, DVR and Mallaiah, K.V. (2007). Laboratory Experiments in Microbiology, 2nd edition. Himalaya Publishing House, Mumbai.
8. Reddy, S.M. and Reddy, S.R. (1998). Microbiology – Practical Manual, 3rd Edition, Sri Padmavathi Publications, Hyderabad.
9. India, F. A. S. A. (2020). Food Safety and Standards Authority of India. *First Amendment Regulation Related to Limit of Metal Contaminant, Aflatoxin and Mycotoxin*.

Course Structure: *Generic Elective 4 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMGE1251	Soil Health Management	02	--	02	--	02

Generic Elective 4 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMGE1251	Soil Health Management	10	10	10	40	--	--	50

SAGMGE1251: *Soil Health Mmanagement*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Generic Elective Course: Agricultural Microbiology

Course Name: Soil Health Management

Course Code: SAGMGE1251

Credits: 02 (Marks: 50) Periods: 30

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Humanities, Faculty of Commerce and Management, Faculty of Interdisciplinary Studies who had completed at undergraduate first year level.

Course Objectives:

The Soil Health Management course aims to:

1. Provide fundamental knowledge of microbial pathogens, their transmission, and their role in soil health.
2. Making the student aware of soil and its health.
3. To make student ready for presentation and articulation skills, exposure to industry and interaction with industry experts.

Course Outcomes:

Upon successful completion of the course, students will be able to:

1. Students know the scope of Agricultural microbiology.
2. To develop the skill of preparation of soil conditioner.
3. To develop and produce farm yard manure, green manure
4. Students develop Skill in producing vermicompost
5. To highlight the importance of organic farming amongst the students

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Introduction to Soil**	**07**
	1.1	Definition of soil, significant developments in soil microbiology and importance of soil health and soil fertility	
	1.2	Soil structure, Physical and chemical properties of soil	
	1.3	Economical and ecological importance of soil	
	1.4	Role of Organic and inorganic matter present in soil	
	1.5	Evaluation of soil structure	
	1.6	Microorganisms in soil and their interactions	

2.0	II	**Decomposition of Organic Matter**	
	2.1	Degradation of Organic Matter: Plant residues, humus and humic acids.	**07**
	2.2	Mineralization and immobilization processes: carbon, nitrogen, phosphorus and sulfur	
	2.3	Role of C/N ratio for maximum decomposition	
	2.4	Effect of residues of crops on plant growth	
	2.5	Soil Sickness	
3.0		**Soil Health maintenance**	
	3.1	Farmyard manure	
	3.2	Vermicomposting	**08**
	3.3	Green manure	
	3.4	Biogas: anaerobic decomposition	
	3.5	Degradation of hydrocarbons	
4.0		**Soil Health Management**	
	4.1	Microbial products influencing Plant growth	
	4.2	Biodegradation of pesticides	
	4.3	Biodegradation of Insecticides	**08**
	4.4	Herbicides and fungicides	
	4.5	Acceleration of Biodegradation	
	4.6	Bioremediation of hydrocarbons	
		Total	**30**

Reference Books:

1. Brock Biology of Microorganisms Thirteenth Edition, Michael T., John M. Martinko, David A. Stahl, and David P. Clark.
2. Prescott, Harley, and Klein's Microbiology Seventh Edition, Joanne M. Willey , Linda M. Sherwood and Christopher J. Woolverton Published by McGraw-Hill.

Course Structure: *Major 1 -Teaching Scheme*

Course Code (2)	Course Name (3)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
SAGMVC1251	Microbial Laboratory Techniques	--	04	--	02	02

Major 1 -Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) or Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of T1 & T2 (6)		CA (8)	ESA (9)	
SAGMVC1251	Microbial Laboratory Techniques	--	--	--	--	20	30	50

SAGMVC1251: *Microbial Laboratory Techniques*

National Education Policy 2020

Swami Ramanand Teerth Marathwada University Nanded

Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Vocational Course: Agricultural Microbiology

Course Name: Microbial Laboratory Techniques

Course Code: SAGMVSC1251

Credits: 02 (Marks: 50) Periods: 60

Course pre-requisite:

1. The course is offered for a student registered for undergraduate second year Programme in the Faculty of Science and Technology who had primary training in the field of Microbiology at undergraduate first year level, for entry level core courses in Microbiology as Major subject.

Course Objectives:

The course aims to:

1. Provide fundamental knowledge of medical laboratory science, including laboratory safety protocols and ethical considerations.
2. Develop competency in basic and advanced laboratory techniques used for the diagnosis of diseases.
3. Train students in the handling, operation, and maintenance of laboratory equipment and instruments.
4. Impart practical skills in sample collection, processing, and analysis of biological specimens.
5. Familiarize students with various diagnostic procedures related to hematology, microbiology, clinical biochemistry, and pathology.
6. Enhance understanding of quality control, laboratory record-keeping, and reporting of results.
7. Prepare students for careers in medical laboratories, hospitals, diagnostic centres, and research institutions.

Course Outcomes:

Upon successful completion of this practical course, students will be able to:

1. Demonstrate knowledge of laboratory safety protocols and ethical guidelines in a medical laboratory setting.
2. Perform routine laboratory procedures, including blood, urine, and stool sample analysis.
3. Operate and maintain essential laboratory instruments such as microscopes, centrifuges, and spectrophotometers.
4. Apply microbiological techniques for the identification of pathogenic microorganisms.
5. Conduct hematological tests such as complete blood count (CBC) and blood grouping.
6. Perform biochemical assays for clinical diagnosis, including blood glucose and liver function tests.
7. Ensure quality control measures in laboratory testing and maintain accurate records of test results.
8. Interpret laboratory findings and assist healthcare professionals in disease diagnosis.
9. Adhere to standard operating procedures (SOPs) in laboratory practices and biosafety measures.
10. Develop teamwork, problem-solving, and communication skills essential for medical laboratory professionals.

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0	I	**Laboratory Safety**	**12 [3 Practicals]**
	1.1	Laboratory Safety Guidelines (Personal Protective Equipment, Chemical & Biohazard Safety)	
	1.2	Standard Operating Procedures (SOPs)	
	1.3	Microbial disposal and waste disposal	
2.0	II	**Laboratory methods of degradation**	**16 [4 Practicals]**
	2.1	Degradation of Starch by microorganisms	
	2.2	Degradation of Cellulose/ Hemicellulose by microorganisms	
	2.3	Degradation of Lignin by microorganisms	
	2.4	Phosphate solubilization using Pikovskaya's medium	
	2.5	Study of Ammonification, Nitrification and Denitrification	

3.0	III	**Qualitative Analysis of Carbohydrate and Protein**	**16 [4 Practicals]**
	3.1	General Test for Carbohydrate- Molisch Test	
	3.2	Test for Reducing Sugar – Benedict's Test	
	3.3	Test for Non reducing Sugar- Benedict's Test	
	3.4	Test for Starch- Iodine Test	
	3.5	Detection of Protein by Biuret Test	
4.0	IV	Acetic Acid Test for Protein	**16 [4 Practicals]**
	4.1	**Qualitative Analysis of Lipids, RNA and DNA**	
	4.2	Qualitative Analysis of lipids by Acrolein test	
	4.3	Qualitative Analysis of lipids by Salkowski test	
	4.4	Qualitative Analysis of RNA by Orcinol test	
	4.5	Qualitative Analysis of DNA by Diphenyl Amine test	
		Total	**60**

Reference Books:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Production Technology, 3rd Edition, New Age International (P) Ltd., New Delhi.
2. A laboratory Manual for undergraduates in Agricultural Microbiology, Microbiology and Biotechnology by Prita Shamrao Borkar, ISBN: 978-93-91768-69-0, https://www.bhumipublishing.com/books/
3. Experiments in Clinical Biochemistry (A hands -on approach) by Zahraa S. Al-Garawi.
4. Practical Clinical Biochemistry by Shruti Mohanty and Aprna Verma. Jaypee Brothers Medical Publishers (P) Ltd. New Delhi.
5. Practical Manual of Biochemistry by G. Sattanathan, S.S. Padmapriya, and B. Balamurali krishnan, Skyfox Publishing Group, Tamil Nadu, India.
6. Clinical Biochemistry by Nanda Maheshwari Jaypee Brothers Medical Publishers (P) Ltd. New Delhi.

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMCT1201 [Applied Microbiology]
Course Code :SAGMCP1201

Marks: 30	**Time: Four hours per day per batch for two consecutive days**

Q1. Quantitative Assessment of Airborne Microorganisms using Settle Plate Method / Isolation and identification of indicator of water pollution (*E. coli*) / Microbiological analysis of drinking water using MPN (Most Probable Number) method / Detection of coliform bacteria in water by membrane filtration technique. 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Determination of Biological Oxygen Demand (BOD) of Water / Determination of Chemical Oxygen Demand of (COD) of water / Isolation of Microorganisms from sewage samples 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. To study the ability of microorganisms to degrade and decolorize synthetic dyes commonly used in industries / Antimicrobial sensitivity testing of waterborne pathogens 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Core Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMCT1202 [Microbes in Agriculture]
Course Code :SAGMCP1202

Marks: 30	**Time: Four hours per day per batch for two consecutive days**

Q1. Isolation of Bacteria and Fungi from soil/ Isolation of microorganisms from rhizosphere, phytosphere and spermosphere/ R: S ratio/ Isolation of soil fungi associated with composting for cellulose and hemi cellulose degradation/ study of Mycorrhizal association in soil. 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Isolation of soil bacteria by streak and pour plate methods/ buried slide method/ tube method/ Isolation of protozoa by ring method/ Direct microscopic examination of soil microorganisms. 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Isolation & study of *Rhizobium sp.* from root nodules of leguminous plants/ *Azotobacter sp.* from rhizosphere soil / Phosphorus solubilising bacteria from soil/ Biocontrol agent *Trichoderma viride* from soil. 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Minor Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMMT1201 [Soil Microbiology]
Course Code :SAGMMP1201

Marks: 30	**Time: Four hours per day per batch for two consecutive days**

Q1. Isolation of microorganisms in soil/ microorganisms from rhizosphere, non -rhizosphere soil/ Determination of R: S ratio/ Isolation of soil bacteria by streak and pour plate methods/ buried slide method/ tube method 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Study of Effect of Temperature on soil microorganisms/Effect of pH on soil microorganisms/ Effect of salinity on soil microorganisms/ Effect of moisture on soil microorganisms 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Study of effect of Detergent on soil microorganisms/ Study of effect of Pesticides on soil microorganisms/ Isolation of pesticide degrading bacteria from soil/ Preparation of Biofertilizer from animal waste 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology

B. Sc. Second Year (Semester – III)

Vocational Skill Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMVC1201 [Microbial Biofertilizer & Bioinsecticides]
Course Code :SAGMVC1201

Marks: 30	**Time: Four hours per day per batch for two consecutive days**

Q1. Isolation, Mass Multiplication, Formulation and Packaging of *Azotobacter spp.* 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Isolation, Mass Multiplication, Formulation and Packaging of *Rhizobium spp* 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Isolation, Mass Multiplication, Formulation and Packaging of PSM / Isolation, Mass Multiplication, Formulation and Packaging of *Bacillus thuringienesis* 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMCT1251[Fundamentals of Microbial Biochemistry]
Course Code :SAGMCP1251

Marks: 30	**Time: Four hours per day per batch for two consecutive days**

Q1. Quantitative estimation of reducing sugar by DNSA Method/ Estimation of Reducing Sugar by Benedict's Method/ Estimation of carbohydrate by the Anthrone method/ Estimation of Protein by Lowrey's Method; Biuret reagent 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Separation of Sugars by Paper Chromatography/ Estimation of Proteins by UV Spectrophotometry at 280 nm/ Precipitation of Proteins Using Salting Out Method (Ammonium Sulfate Precipitation)/ Separation of Amino Acids by Thin Layer Chromatography 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Estimation of DNA by Diphenylamine Reaction/ Estimation of RNA by Using Orcinol Method/ Estimation of DNA Concentration Using UV Spectrophotometry at 260 nm/ Estimation of Free Fatty Acid Value (FFA) 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Core Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMCT1252 [Microbial Metabolism]
Course Code :SAGMCP1252

Marks: 30	**Time: Four hours per day per batch for two consecutive days**

Q1. Enrichment, culturing and isolation of phototrophs/ Cyanobacteria- *Nostoc/ Anabaena/* Preparation of media for culturing autotrophic and heterotrophic microorganisms/ Demonstration of: i) Ammonification ii) Nitrification iii)Denitrification iv) Nitrate reduction v) Sulfate reduction

10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Citric acid fermentation & Extraction of Citric acid/ Estimation of citric acid by titrimetric method/ Methane production by anaerobic conditions/ Demonstration of ETC in bacteria.

10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. Alcoholic fermentation by *Saccharomyces cerevisiae/* Lactic acid fermentation/ Acetone butanol fermentation.

10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Minor Practical Course:Agricultural Microbiology
Course Name: Practicals based on Course SAGMMT1251 [Food and Diary Microbiology]
Course Code :SAGMMP1251

Marks: 30	**Time: Four hours per day per batch for two consecutive days**

Q1. Direct Microscopic Count (DMC) of food / Standard Plate Count (SPC) of food / Methylene Blue Reduction Test (MBRT) / Phosphatase Test 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Determination of Taste, Flavour and Appearance; Milk pH; Alcohol Test/ Presence of Starch: Iodine test; Soda: Rosalic acid test; Sugar: Resorcinol test; Urea: Dimethyl amino benzaldehyde test
10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3. To demonstrate Microbial count of Proteolytic/ Lipolytic/ Psychrotrophic/ Halophilic/ acidophilic microorganisms in milk 10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

PROFORMA FOR PRACTICAL EXAMINATION

Swami Ramanand Teerth Marathwada University Nanded
Faculty of Science and Technology

B. Sc. Second Year (Semester – IV)

Vocational Skill Practical Course: Agricultural Microbiology
Course Name: Practicals based on Course SAGMVC1251 [Microbial Laboratory Techniques]
Course Code :SAGMVC1251

Marks: 30	**Time: Four hours per day per batch for two consecutive days**

Q1. Isolation of starch; Cellulose; Hemicellulose; Lignin degrading microorganisms/ Phosphate solubilizing Bacteria.

10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q.2. Demonstrate the presence of Carbohydrate- Molisch Test/ Reducing Sugar and non-reducing Sugar– Benedict's Test/ Detection of Protein by Biuret Test/ Test for Starch- Iodine Test

10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02

Q3.Qualitative Analysis of lipids by Acrolein test/ lipids by Salkowski test/ RNA by Orcinol test/ DNA by Diphenyl Amine test

10

Approach	- 03
Requirements	- 01
Procedure	- 02
Technique	- 02
Result and Observation	- 02